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LUMINARY Memo #126

To: Distribution
From: D. Eyles
Date: 2 December 1969
Subject: Delta Guidance

As I leave for a 3 - 4 week holiday au bord de la Mediterranean, delta-guidance stands as follows:

With a few patches (see Luminary Memo #123), AMELIA 11 is running well. This program is like Luminary 130 except that it contains the new guidance equations described in Luminary Memo #115. Dave Moore has a deck for running AMELIA on the digital simulator - anyone interested should snatch copies of that deck. Three new inserts apply especially to AMELIA: TEDIT DELDIT, the delta-guidance equivalent of BANDIT; INSERT DELPAD, containing pad-loads for AMELIA; and INSERT AMY11, patches.

The tests run so far on this revision are

(1) Nominal run, without terrain.

(2) A run with a lateral velocity noise spike at TGO -50 in P64. The spike consisted of 45 pulses thrown into the Y-PIPA; this is equivalent to a 7.5 f/s radar noise spike incorporated with a weighting factor of .2. This test showed oscilliatory behavior in roll (see plot in Luminary Memo #123). This calls for MAC analysis which is in progress.

(3) A run with 8 right redesignator clicks in P64, at about 6000 feet altitude. The ground track between the point where the redesignation was put in and the landing site is a much straighter line than in an equivalent LUMINARY run.

(4) A run with a 10000 foot uprange N69 at the start of P64. Of course a pulse-out and rapid pitch up (toward the horizontal) immediately occurred, but visibility was recovered within 22 seconds.

(5) A run with a 1000 foot downrange N69 at the start of P64. A pulse-out occurred here too - an unexpected happening since confirmed in MAC runs.

(6) Run with a 50000 downrange N69 at the start of the burn, which actually used about 23 f/s less delta-v than the nominal run. (This run also included a noise spike as in test (2).)

Changes in delta-guidance still to come include putting the velocity error on the downlink. This error, between the nominal and the actual velocity along the Z-axis of the guidance coordinate frame, is used in P63 to decide when to pulse the engine, and thus provides the same sort of check on throttle behavior as FC does in LUMINARY.

Additionally, DAP (or DAP-related) changes will probably be needed. George Kalan is concerned about two things: (A) that in the event of an undetected jet-on failure in P63 the LM might loose attitude control when the engine is throttle-up (as it repeatedly is) in P63; (B) that the throttle pulsing in P63 will unduly excite slosh.

But in terms of wringing-out the LGC version of the delta-guidance system these things are periferal, and hopefully AMELIA as is will serve that purpose for a month.